

## **SECTION 6**

### **FACILITY CONCEPTS FOR SHORT LISTED TECHNOLOGIES**

#### **6.1 GENERAL**

In order to allow a more detailed evaluation, pre-conceptual designs were done for the three short-listed technologies in Section 5. The designs include the basic ancillary systems needed to implement the given technology. The three integrated facilities are given the following names:

- Plasma Generating Station
- Metal Recycling Plant
- Gypsum Recycling Plant

The integrated facilities pre-conceptual design includes a block diagram, a facility functional block flow diagram and a facility plot plan. The pre-conceptual characterization of the options also identifies the functional, operational and performance aspects of the overall system and the key unit operations. Based on the pre-conceptual characterization of the facilities, rough order of magnitude (ROM) capital and operating costs for each of the alternatives are presented herein.

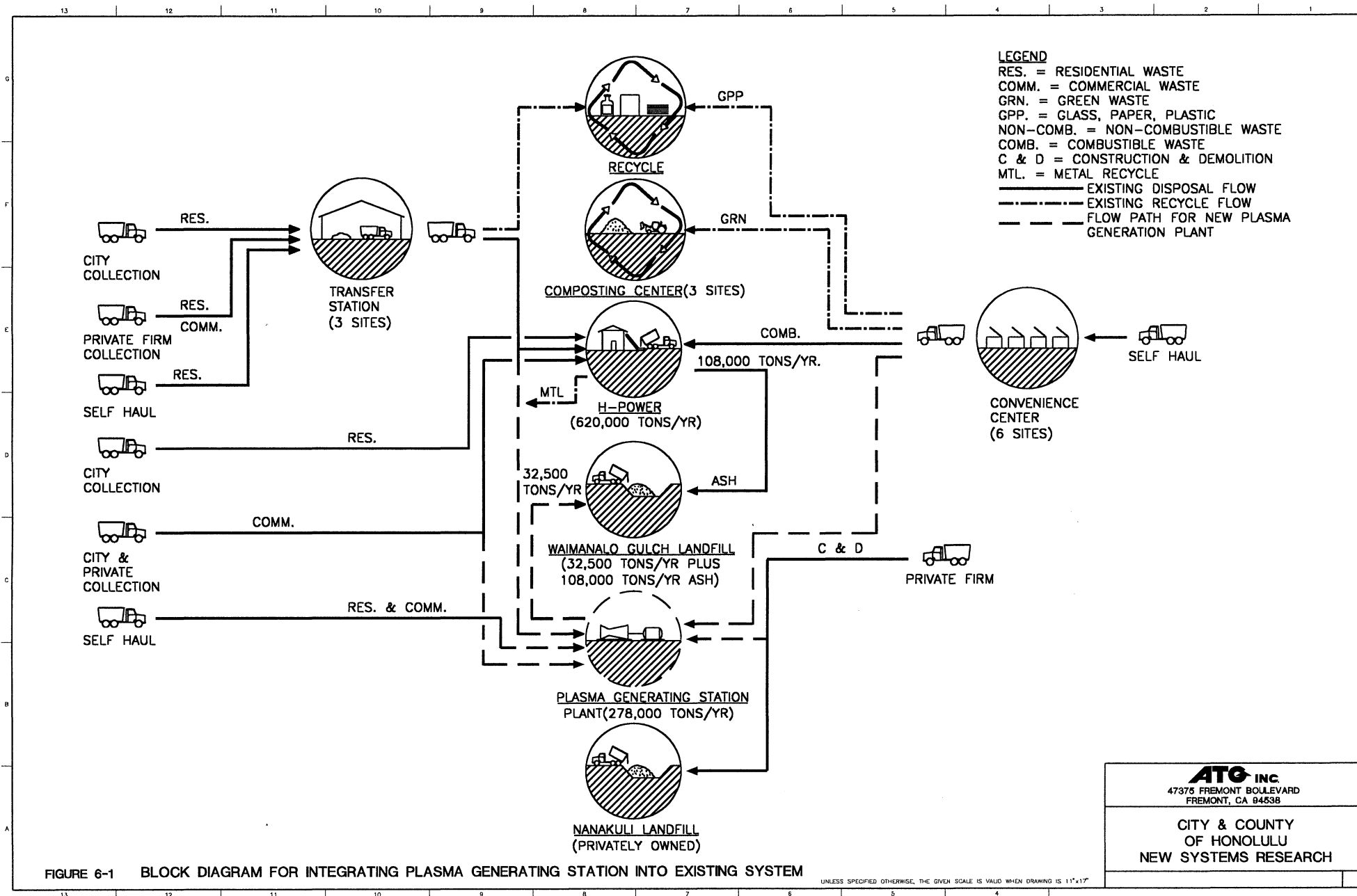
#### **6.2 PLASMA GENERATING STATION**

The integration of a plasma generating facility into the existing City refuse management system is shown on **Figure 6-1**. **Figure 6-2** shows a functional flow diagram for the station. **Figure 6-3** shows a footprint of the major unit operations and the overall land requirements for the Plasma Generating Station.

##### **6.2.1 Facility Description**

The Plasma Generating Station will use a plasma gasification and vitrification system and other ancillary equipment to convert the incoming trash into electricity, which can be fed to the Hawaiian Electric Company (HECo).

The station will be located on a 15-acre site and will have an incoming truck receiving, staging and dumping area. An area in the station will be provided for accumulating the incoming waste as needed for surge storage.



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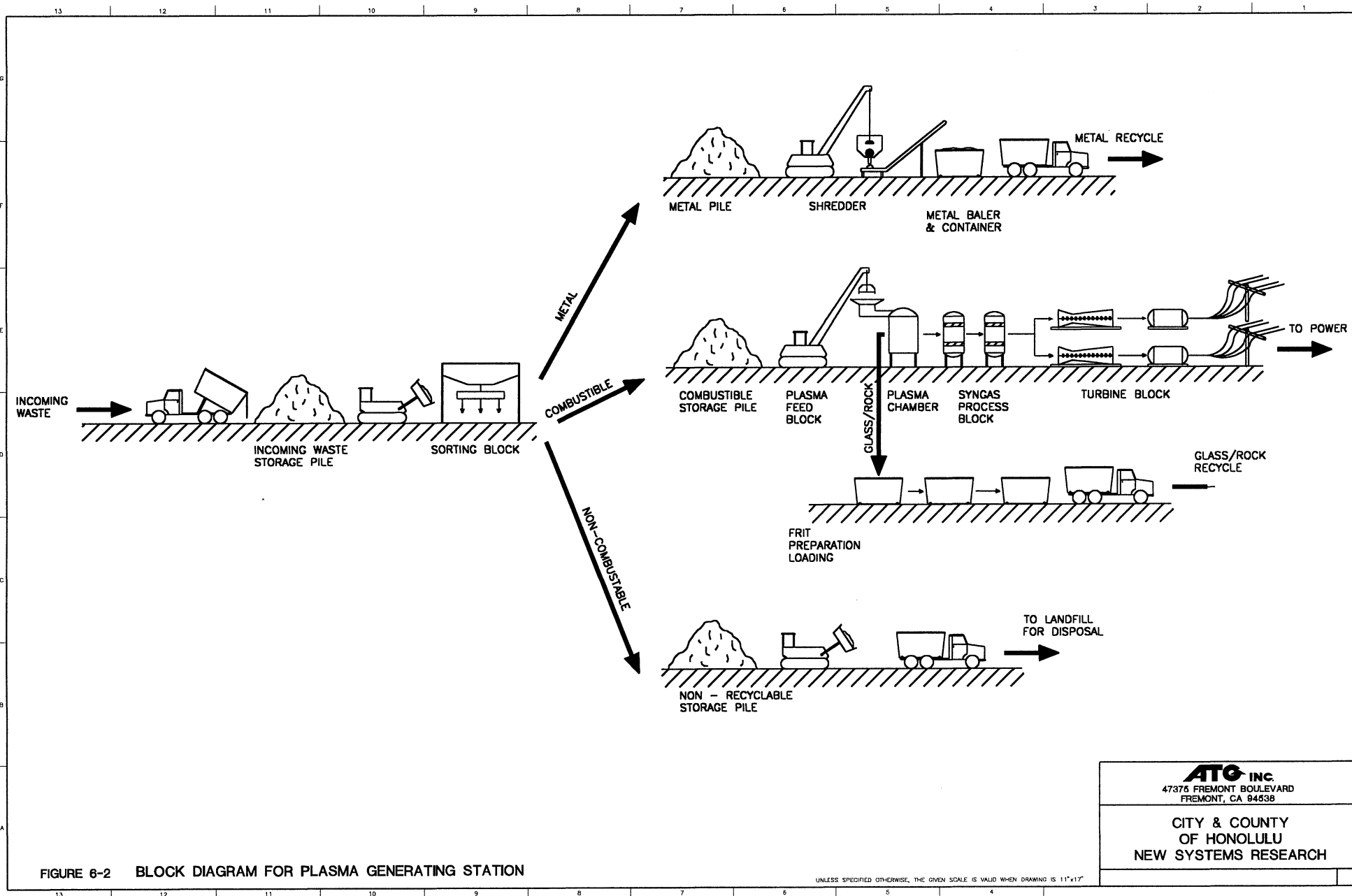
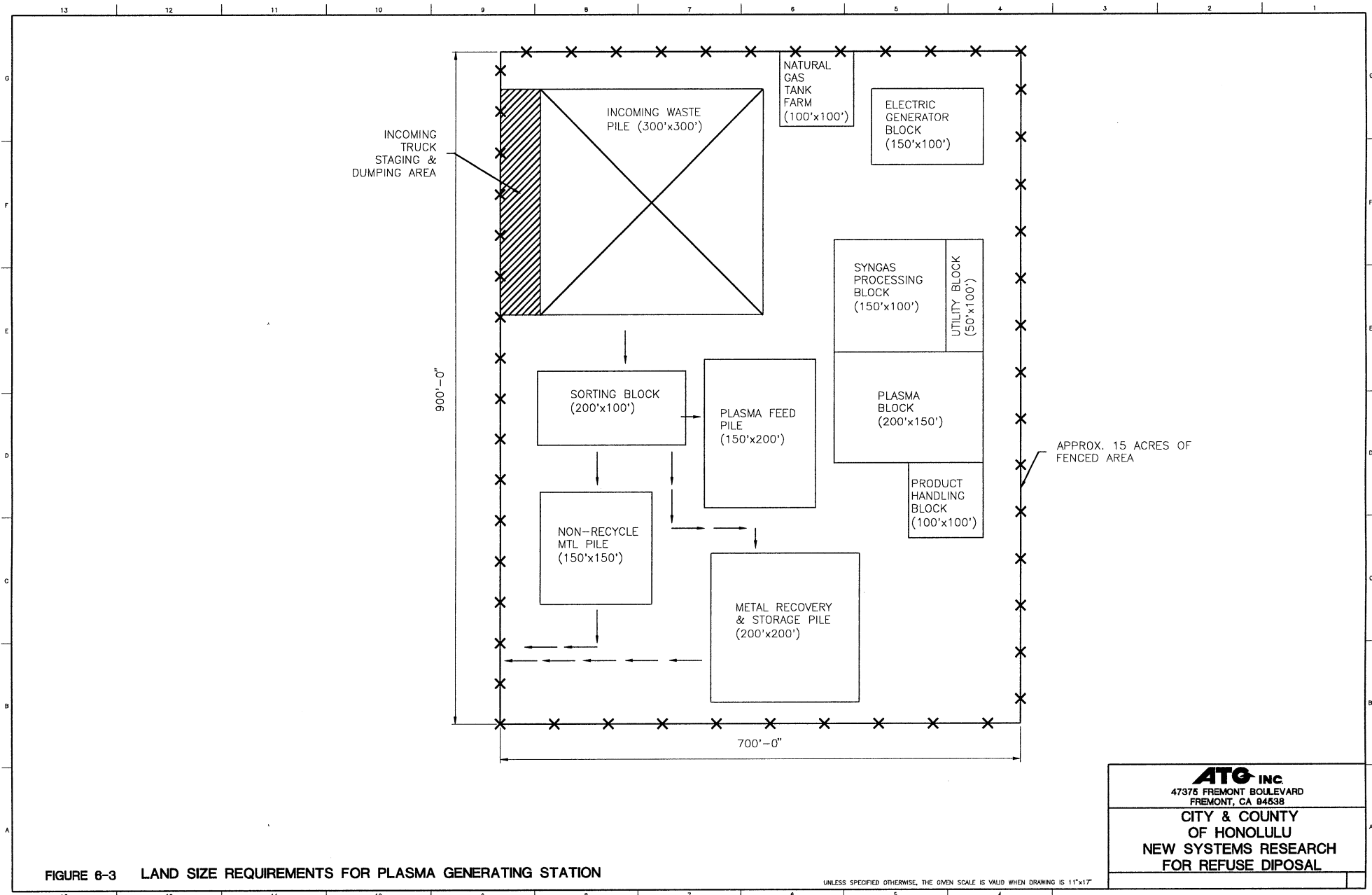


FIGURE 6-2 BLOCK DIAGRAM FOR PLASMA GENERATING STATION

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As shown in **Figure 6-1**, almost all of the City, private firm and self-hauling refuse trucks going to the Waimanalo Gulch Landfill will be diverted to the Plasma Generating Station. Construction and demolition waste haulers will be encouraged to segregate wood-containing debris waste at its source and transport it directly to the Plasma Generating Station.

The material in the incoming waste storage pile will be transferred to a sorting unit. The sorting unit considered in this study is based on an integrated system being marketed by Lube-USA. The unit will have capability to segregate the waste into three categories: combustible, metals and non-recyclable refuse. The sorting unit will transfer each of the three refuse streams to a storage pile. These include storage piles for the refuse to be fed to the plasma unit, metal recycling and the non-recyclable material that must be shipped offsite.

The plasma unit considered in this study is based on the technology being marketed by Integrated Environmental Technology (IET) of Richland, Washington. The unit will have a feed system that will prepare and feed the incoming refuse to the plasma chamber. The IET plasma chamber will have both a direct current (DC) plasma arc system and a Joule heating system. The plasma chamber will be designed for operation in a gasification mode. A treatment train will be provided to treat the gaseous product to produce a synthesis gas (or syngas). The inert product, metal, glass/rock will be converted into re-usable material by a product handling subsystem.

A set of turbine generators, including all of the associated electrical and mechanical support units, will be provided to convert the plasma system syngas into electricity. The gas turbine considered in this study is based on industrial gas turbine technology being marketed in the US by TUMA Turbinematch, SA, of Switzerland.

The turbine block will also have a natural gas tank farm. The turbine will use natural gas during the station start-up, maintenance down times, and idle periods. During normal operation, it is anticipated that approximately 60% to 80% of the electricity will be used internally. The remaining power produced by the station will be sold.

The sorting system at the Plasma Generating Station will be upgraded to include metal recovery, since this feature can be added with only minor capital cost. The metal sorting part of the station will include magnetic separation devices at the sorting station, bulk size reduction units, and metal shredding units.

The station will consist of the following unit operations:

- **Incoming Truck Staging & Dumping.** Incoming waste will be brought to the station by refuse trucks and unloaded in the incoming truck staging area. A loader will be provided to pile up the incoming waste.
- **Sorting.** The sorting unit will have material transport conveyors, receiving hoppers and a primary and secondary crushing, sorting, and separation mechanisms. The unit reduces the size of the input feedstock and sorts the output into three waste streams: combustible, metals, and non-recyclable refuse. The metal sorting unit has a crane loader with a magnetic lifting rig. The loader transfers the material from the sorting and metal pile to various unit operations.
- **Metal Recycle.** The metal recycle unit will have a crane loader with a magnetic lifting rig. The loader transfers the material from the pile and places it into a shredder. The shredder reduces the size of the metals.
- **Non-Recyclable Waste Loading.** The non-recyclable waste loading unit has a surge storage pile, loaders and dump trucks. The trucks transport the waste to the Waimanalo Gulch Landfill.
- **Plasma Feeder.** The plasma feed unit has a surge storage pile, loaders and a feed conveyor.
- **Plasma Chamber.** The plasma chamber unit will consist of a refractory-lined plasma chamber, an air-lock feeder, a metal product discharge port, a glass/rock product discharge port, a DC arc plasma system, a joule heating electrode system, and the associated controls.
- **Syngas Processing Unit.** The syngas processing unit consists of an acid gas and particulate filtration train, induced draft fans and final particulate filters.

- **Turbine Generator.** Two sets of turbine generators convert the syngas to electricity. The generators will use either natural gas or syngas or both. The unit also includes a switchyard that will integrate the power from the station with the outside electrical transmission grid.
- **Natural Gas Tank Farm.** The tank farm stores natural gas as needed for the operation of the turbine generators during the initial start-up of the facility and to subsidize the generation of the syngas whenever the plasma unit is down for maintenance and during idle period.
- **Product Handling.** The product handling unit converts molten glass/rock from the plasma chamber into a grit of gravel size so that it can be used for road construction or other applications.

#### 6.2.2 Functional and Operational Requirements

It is envisaged that the facility will meet the following functional and operational requirements.

- **Function.** The Plasma Generating Station will receive, sort and process for recycling and energy recovery in the form of electrical power, a major portion of the City refuse that is currently being sent to Waimanalo Gulch. The station will segregate combustible material and metals from the incoming wastes and return any non-recyclable refuse to Waimanalo Gulch for landfill disposal. Metals will be size-reduced and packaged in containers ready for shipment to offshore recycling steel mills. The station will use the segregated combustible refuse as a feedstock to the plasma gasification/vitrification system. This plasma system will convert the organic content of the feedstock into a synthesis gas, which will be cleaned and used in a turbine generator to produce electricity. The inert material, including metals, contained in the station will be converted into a material that is recyclable.
- **Operations.** Almost all of the refuse trucks currently transporting refuse to Waimanalo Gulch will be diverted to the Plasma Generating Station. It is estimated that the refuse received by the Plasma Generating Station will be approximately 278,000 tons per year. The plasma system will process approximately 70% (or 195,000 tons per year) of the incoming refuse. The composition of this waste is anticipated to be as follows:

8.9% paper + 5% plastic + 31.2% wood + 16% furniture and carpet + 10%  
inorganic composite = 70%

It is estimated that the remaining 30% (or  $30\% \times 278,000 \text{ tons/yr} = 83,000 \text{ tons/yr}$ ) of the incoming refuse will be either scrap metal or a non-recyclable material (such as concrete and soils). The scrap metal can be processed by the metal recycling portion of the station. Non-recyclables (such as concrete and soils) are not economical for vitrification and must be sent to the landfill for disposal. The metal recycling portion of the station will recover approximately 90% of the available scrap metal (i.e.,  $0.9 \times 12.3\% \times 278,000 = 31,000 \text{ tons per year}$  from the refuse currently being sent to the Waimanalo Gulch Landfill. The remaining refuse, approximately 52,000 tons/year will be sent to the landfill. Also, it is estimated that approximately 10% of the waste processed by the plasma system (or  $70\% \times 278,000 \text{ tons/yr} \times 10\% = 19,500 \text{ tons per year}$ ) will be a glass-like material which will be recycled for use as road or construction concrete aggregate. The station will operate 24 hours per day and 330 days per year. To calculate the operating cost, we have assumed that the waste receiving and dumping operations will operate approximately 7 hours per day and 355 days per year. The metal recycling receiving operations will operate approximately 7 hours per day, 22 days per month and 12 months per year.

- **Performance.** Metal recovery efficiency will be approximately 90% of the total incoming ferrous metals. Waste segregated for plasma feed operations will have approximately 70% combustible material. The station will be self-powered and will produce approximately 300 kwh of excess power per ton of waste processed by the plasma unit.
- **Permitting.** The station will require an NPDES permit for liquid discharges. Clean air permit will be required for turbine generator units. Fugitive emissions will be minimized through design. A State of Hawaii, Department of Health, solid waste permit will be required for construction and operation of the facility.
- **Design, Installation and Construction.** The station will be designed, installed and constructed to meet the national and local codes and standards. All equipment and systems will be designed for outdoor installation. Equipment will be pre-assembled and tested at the factory to minimize delays due to field start-up problems.



### **6.3 METAL RECYCLING PLANT**

The integration of a metal recovery plant into the existing City refuse management system is shown on **Figure 6-4**. **Figure 6-5** shows a functional flow diagram for the plant. **Figure 6-6** shows the footprint for the major unit operations and the overall land requirements for the metal recycling plant.

#### **6.3.1 Facility Description**

The metal recycling plant will use sorting and shredding technologies to recover ferrous metals from the incoming refuse. The recovered metals will be sent to the existing recycling companies.

Special containers (e.g., roll-off bins) for metal recycling will be placed at the Waimanalo Gulch Landfill. The operating personnel will remove metal containing objects from the incoming refuse and place them on the recycling containers. Trucks, provided by the metal recycling plant, will transport the containers to the metal recycling plant. Private C&D waste haulers will be encouraged to segregate metal-containing refuse at its source and transport it directly to the recycling plant.

The plant will be located in an approximately 8-acre site and will have an incoming truck receiving, staging and dumping area. An area in the station will be provided for accumulating the incoming waste as needed for surge storage.

The material in the incoming waste storage pile will be transferred to a sorting unit. The sorting unit considered in this study is based on an integrated system being marketed by Innovative Recycling Systems, Inc., of Solon, Ohio. The unit will have capability to segregate the waste into two categories: metals and non-recyclable refuse. The sorting unit will transfer each of the two refuse streams to a surge storage pile.

The metal recycling unit will include magnetic loading devices that will transfer the metals to various unit operations. First the material will be sent to an area for bulk size reduction using large hydraulic shears and balers. The size-reduced material will be placed on a conveyor that leads to a shredder. The metals will be shredded and made ready for shipment to markets.

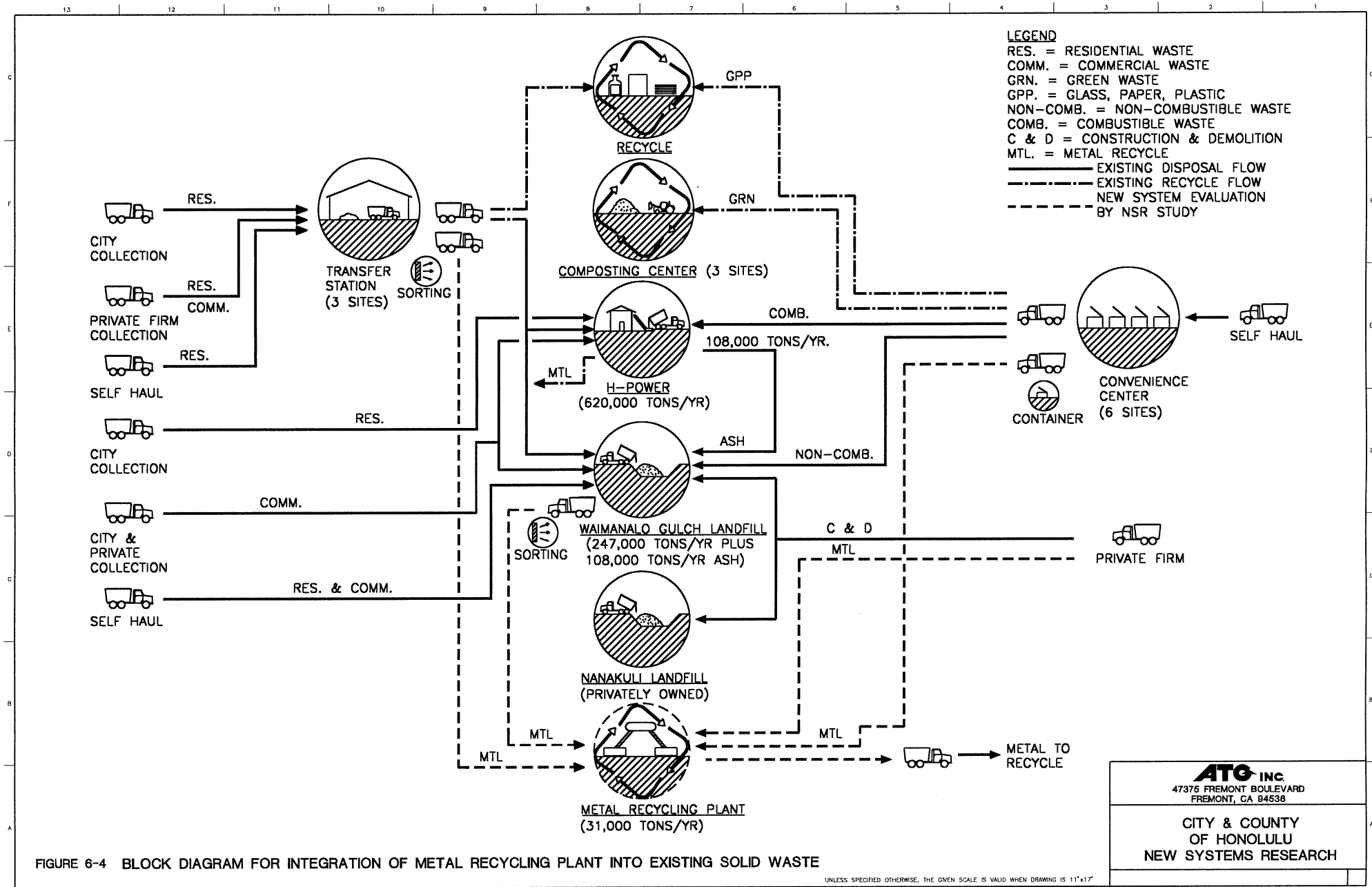


FIGURE 6-4 BLOCK DIAGRAM FOR INTEGRATION OF METAL RECYCLING PLANT INTO EXISTING SOLID WASTE

UNLESS SPECIFIED OTHERWISE, THE GIVEN SCALE IS VALID WHEN DRAWING IS 11"x17"

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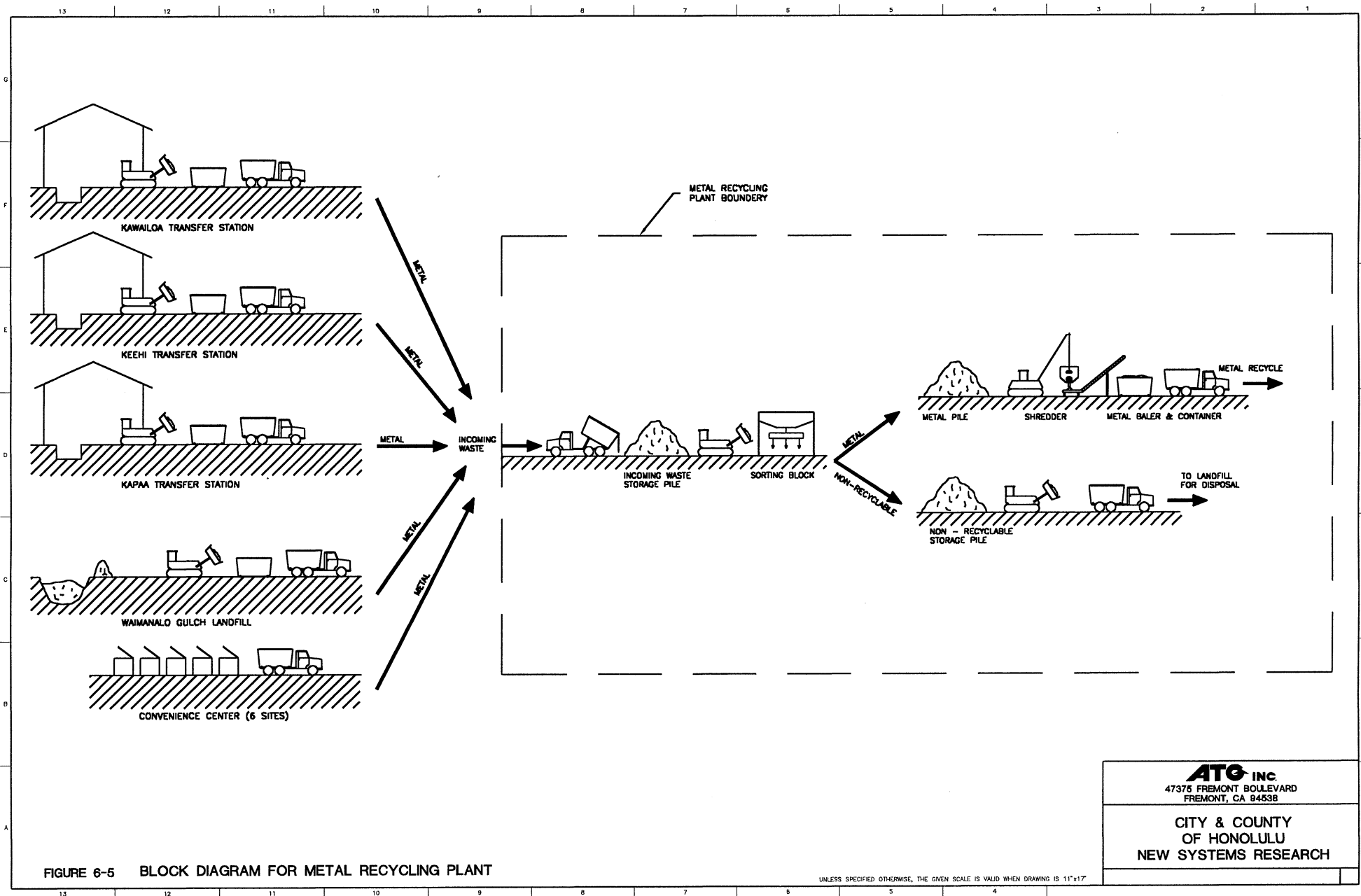
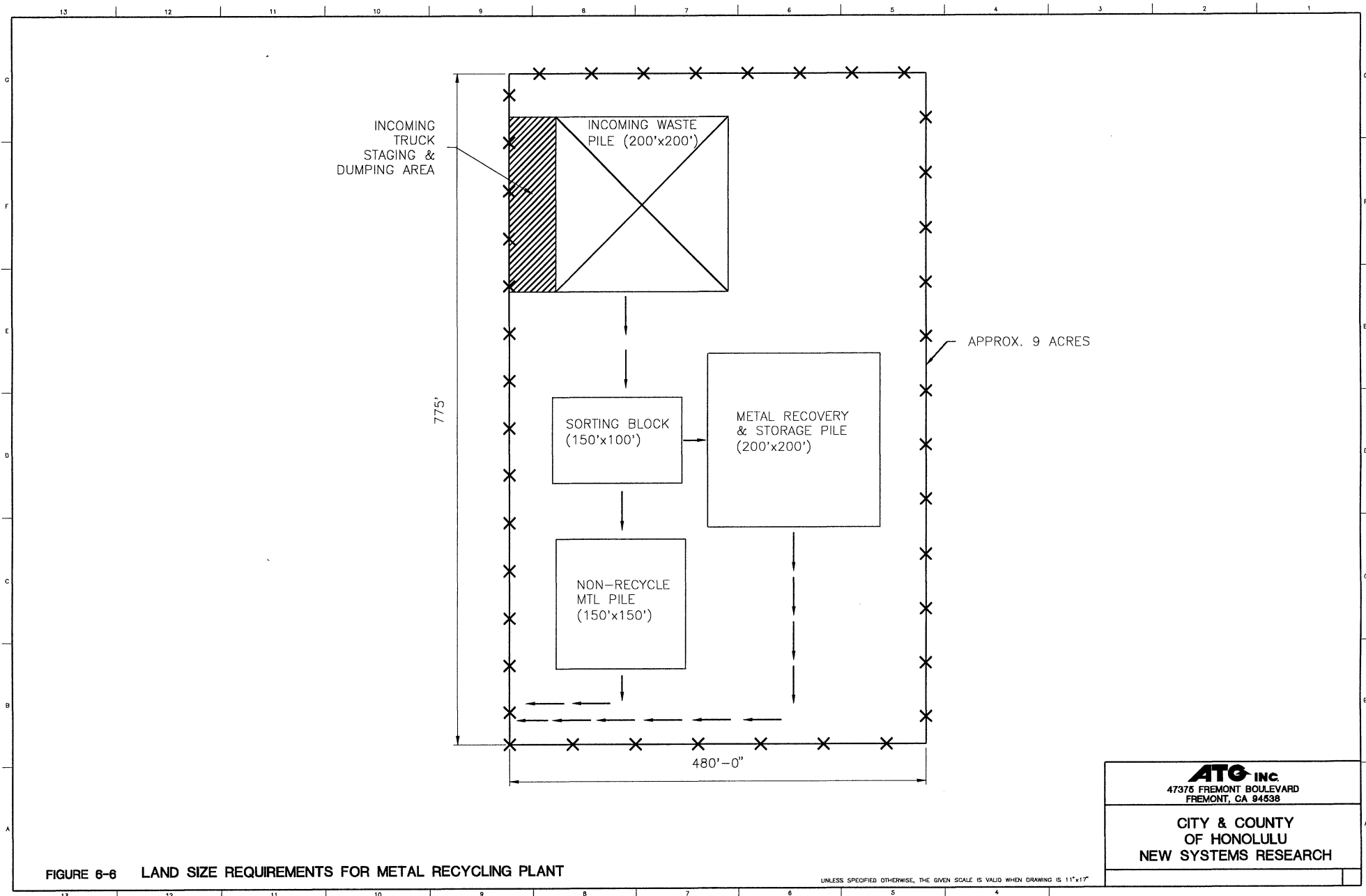


FIGURE 6-5 BLOCK DIAGRAM FOR METAL RECYCLING PLANT

UNLESS SPECIFIED OTHERWISE, THE GIVEN SCALE IS VALID WHEN DRAWING IS 11"x17"

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**FIGURE 6-6 LAND SIZE REQUIREMENTS FOR METAL RECYCLING PLANT**

UNLESS SPECIFIED OTHERWISE, THE GIVEN SCALE IS VALID WHEN DRAWING IS 1"=17'

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The plant will consist of the following unit operations:

- **Incoming Truck Staging & Dumping.** Incoming waste will be brought to the facility by trucks and unloaded in the incoming truck staging area. A loader will be provided to pile up the incoming waste.
- **Sorting.** The sorting unit will have material transport conveyors, size reducing devices, and magnetic separation mechanisms. Large structural steel members will not be fed to the sorting unit. Only bulk composite material will be processed by the sorting device. The unit reduces the size of the input feedstock and sorts the output into two waste streams: metals, and non-recyclable refuse.
- **Bulk Size Reduction.** The bulk size reduction area will have large hydraulic sheer and plasma torches that will be used to reduce large metal objects and structural members to a size that can be fed to the shredding devices.
- **Shredders.** The shredder reduces the size of the metals.
- **Non-Recyclable Waste Loading.** The non-recyclable waste loading unit has a surge storage pile, loaders and dump trucks.

#### 6.3.2 Functional and Operational Requirements

It is envisaged that the metal recycling plant will meet the following functional and operational requirements.

- **Function.** The metal recycling plant will receive, sort and process for recycling bulk and composite material containing ferrous metal. The plant will segregate metals from the incoming wastes and return any non-recyclable refuse to the Waimanalo Gulch Landfill for disposal. Metals will be size reduced and delivered to the recycling companies.
- **Operations.** It is estimated that the metal recycling plant will receive approximately 11.5% (6.7% ferrous metals and the 4.8% mixed/other material) of the 195,000 tons of refuse currently being sent to the Waimanalo Gulch Landfill. This is approximately 22,500 tons per year. The plant will recover approximately 90% of the incoming metal, which is roughly 20,200 tons of metal per year. The remaining amount, approximately 2,300

tons/year, will be sent to the landfill. The metal recycling plant will operate approximately 7 hours per day, 22 days per month and 12 months per year.

- **Performance.** The metal recovery efficiency will be approximately 90% of the total incoming ferrous metals.
- **Environmental Permitting.** The plant will require a Clean Air Act permit for the dust collector. No other major environmental permits are anticipated. Fugitive emissions will be minimized through design, and will also be subject to permitting. A State of Hawaii, Department of Health, solid waste permit will be required for construction and operation of the facility.
- **Design, Installation and Construction.** The plant will be designed, installed and constructed to meet the national and local codes and standards. All equipment and system will be designed for outdoor installation. Equipment will be pre-assembled and tested at the factory to minimize delays due to field start-up problems.

#### **6.4 GYPSUM RECYCLING PLANT**

The integration of a gypsum recycling plant into the existing City refuse management system is shown on **Figure 6-7**. **Figure 6-8** shows a functional flow diagram for the plant. **Figure 6-9** shows the footprint for the major unit operations and the overall land requirements for the gypsum recycling plant.

##### **6.4.1 Facility Description**

The gypsum recycling plant will use pulverizing and screening technologies to recover gypsum from gypsum wallboard. The descriptions contained in this report are based on systems being marketed by Andela Tool and Machine, Inc., of Richfield Springs, NY, and Gyp-Pack Container, Inc., of Tonowanda, NY.

Roll-off bins for gypsum recycling will be placed at the Waimanalo Gulch Landfill. The site operator will remove the discarded gypsum wall boards from the incoming refuse and place them in the recycling containers. Trucks, provided by the gypsum recycling plant, will transport the containers to the gypsum recycling plant. Private C&D waste haulers will be encouraged to segregate gypsum-containing refuse at the source and transport it directly to the recycling plant.

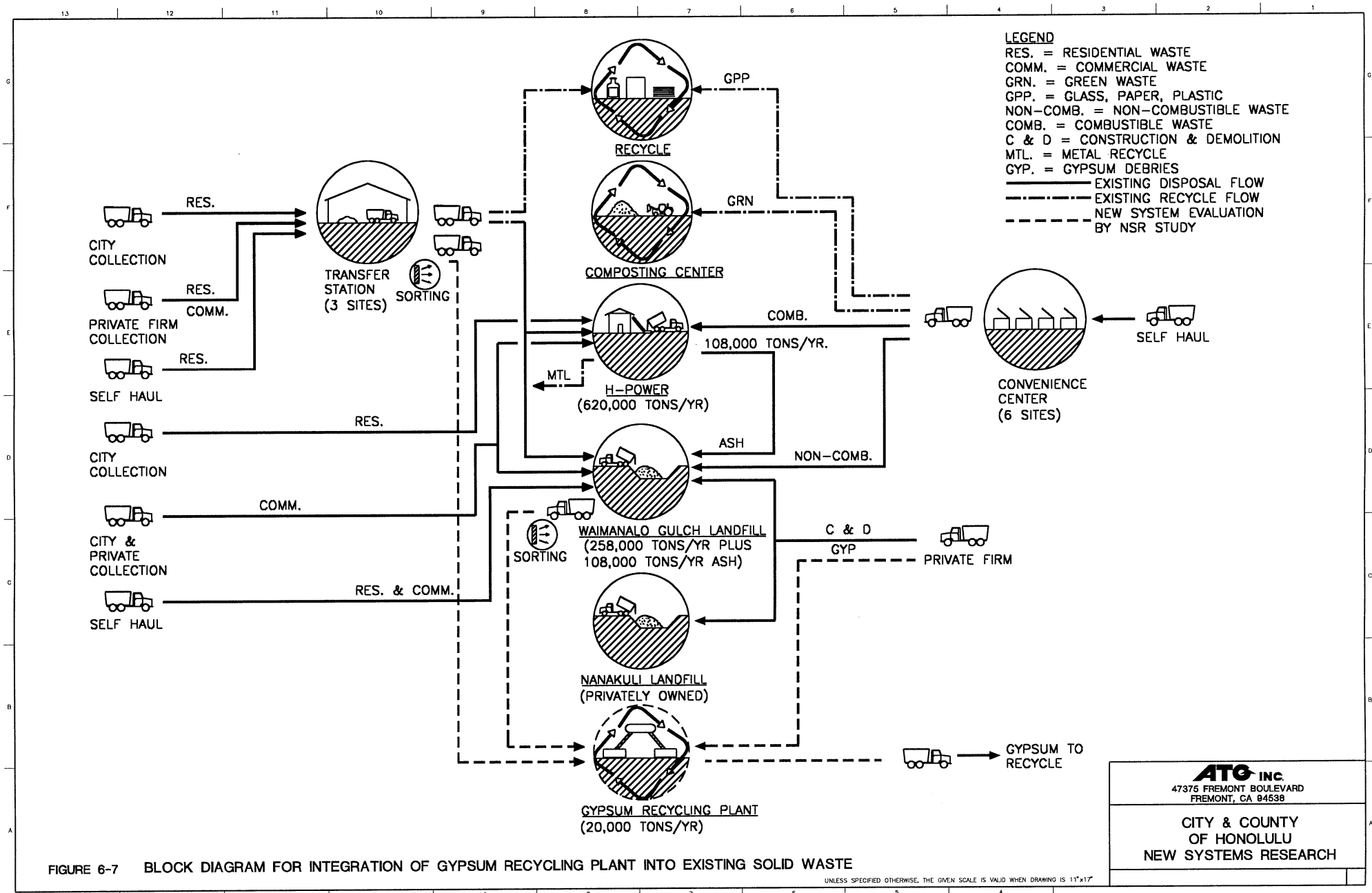


FIGURE 6-7 BLOCK DIAGRAM FOR INTEGRATION OF GYPSUM RECYCLING PLANT INTO EXISTING SOLID WASTE

UNLESS SPECIFIED OTHERWISE, THE GIVEN SCALE IS VALID WHEN DRAWING IS 11"X17"

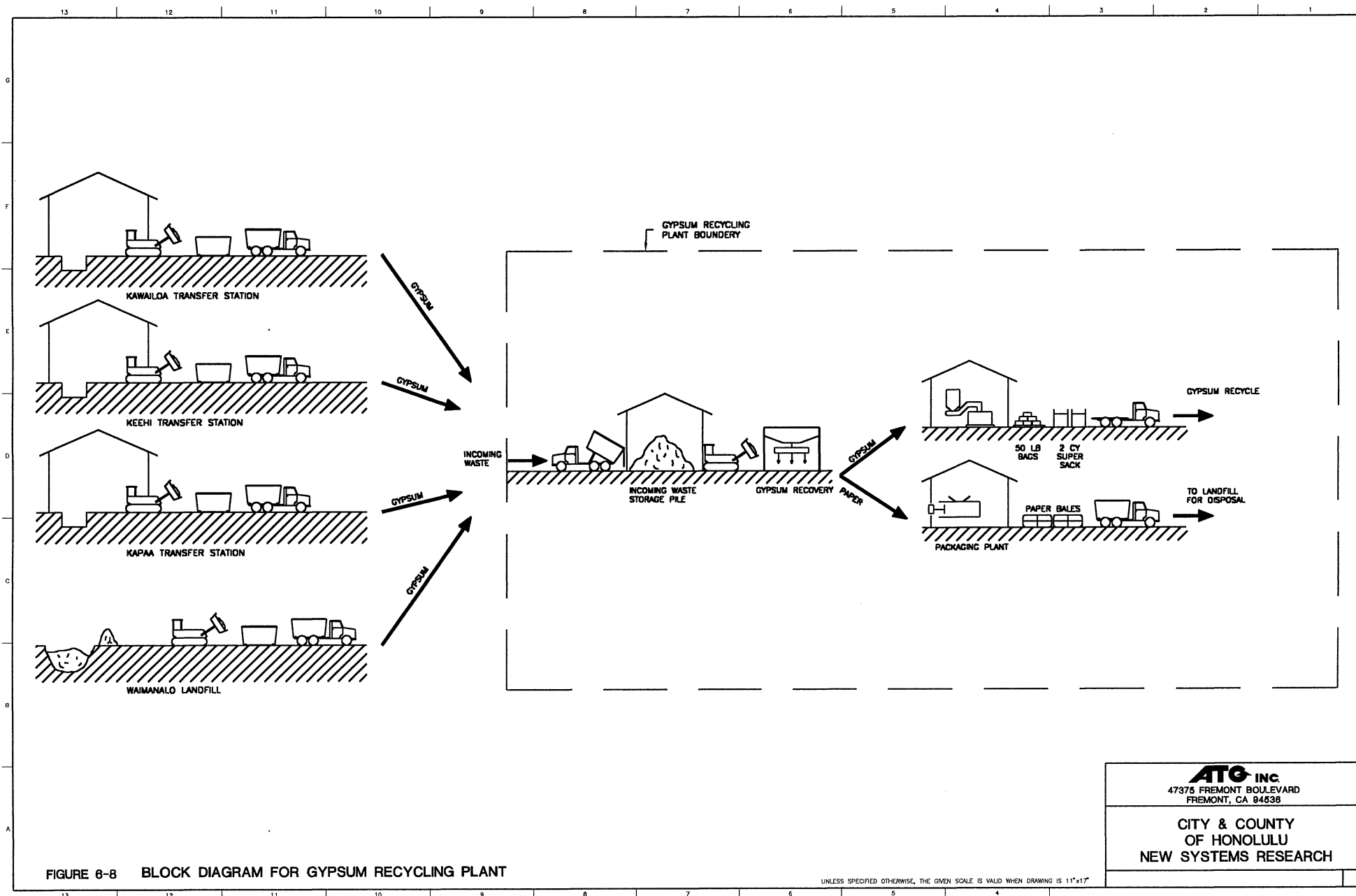


FIGURE 8-8 BLOCK DIAGRAM FOR GYPSUM RECYCLING PLANT

UNLESS SPECIFIED OTHERWISE, THE GIVEN SCALE IS VALID WHEN DRAWING IS 11"x17"

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INCOMING  
TRUCK  
STAGING &  
DUMPING AREA

INCOMING WASTE  
PILE (150'x100')

APPROX. 4 ACRES

500'

GYPSUM RECOVERY  
STORAGE SILO &  
BAGGING STATION  
(200'x200')

300'

FIGURE 6-9

LAND SIZE REQUIREMENTS FOR GYPSUM RECYCLING PLANT

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The gypsum recycling plant will receive the incoming gypsum, crush and separate the non-recyclable material and package the recyclable gypsum. The packing unit operation will bag gypsum in either 50-pound bags or 2-cubic yard plastic sacks (super-sack). The packaged products will be sold as a soil additive in bags at retail markets or in bulk to the agricultural industry. Sale of recycled gypsum product to other markets, such as oil absorbents in the environmental industry, will also be pursued.

The plant will be located on a 4-acre site and will have an incoming truck receiving, staging and dumping area. An area in the station will be provided for surge storage of the incoming gypsum wallboard. The storage area will be covered to keep rainwater away from the scrap wallboard storage area.

The scrap wallboard will be spread on a flat area in the storage building. A loader equipped with a wheel crusher/roller will be performing an initial bulk size reduction. The crushed scrap wallboards will then be moved by belt conveyor to the infeed hopper. The hopper delivers a metered quantity of gypsum to a separator. The separator will remove the paper facing from the gypsum wallboard and break down the gypsum core into powder. The output from the separator is delivered to a trommel separator.

The trommel screens the paper from gypsum and deposits each product on a separate conveyor beneath the trommel. The gypsum conveyor delivers the gypsum to the bagging station silos. At the bagging station, gypsum will be filled into special bags and containers designed for each market.

The paper waste will be sent to H-POWER for use as fuel and for energy recovery.

- **Incoming Truck Staging & Dumping.** Incoming roll-off bins will be brought to the facility by trucks. This unit operation will also accept dump trucks. A loader will be provided to assist in the gypsum unloading, piling and transfer operations. Before feeding the gypsum to the separator unit, the loader will spread the pile into a flat layer. A wheeled crusher will perform initial bulk size reduction.

- **Separator** The separator unit will have infeed conveyors, hoppers, pulverizers, trommels, and product output conveyors. The unit receives dry gypsum wall board, crushes the boards, separates the facing paper from gypsum, grinds the gypsum to a powder consistency and deposits the gypsum and paper output on discharge conveyors.
- **Bagging Station.** This unit operation will have receiving silos, transfer conveyors, load cell weight platforms and bag and container filling stations. The unit will surge store recyclable gypsum and produces various sizes of bagged gypsum ready for transportation to outside markets.

#### 6.4.2 Functional and Operational Requirements

The gypsum recycling plant will meet the following functional and operational requirements.

- **Function.** The gypsum recycling plant will receive pre-sorted scrap gypsum wallboards. The plant will remove the facing paper from scrap wallboard, grind gypsum to a powder, and bag the powdered gypsum ready for sale in various markets. The paper waste will be taken to H-POWER for use in energy recovery.
- **Operations.** It is estimated that the gypsum recycling plant will receive approximately 7% of the City's refuse that is currently being sent to Waimanalo Gulch. This is equal to 20,000 tons per year. The plant will recover approximately 90% of the incoming gypsum, which is roughly 18,000 tons per year. The remaining amount, approximately 2,000 tons/year, is waste paper that will be sent to H-POWER. The gypsum recycling plant will operate approximately 7 hours per day, 22 days per month and 12 months per year.
- **Performance.** The gypsum recovery efficiency will be approximately 90% of the total incoming scrap gypsum.
- **Environmental Permitting.** The plant will require a Clean Air Act permit for the dust collector. No other major environmental permits are anticipated. Fugitive emissions will be minimized through design. A State of Hawaii, Department of Health, solid waste management permit will be required for construction and operation of the facility.

- **Design, Installation and Construction.** The plant will be designed, installed and constructed to meet the national and local codes and standards. All equipment and systems will be designed for outdoor installation. Equipment will be pre-assembled and tested at the factory to minimize delays due to field start-up problems.

## **6.5 ROM LIFE-CYCLE COSTS**

### **6.5.1 ROM Capital Cost Estimate**

ROM capital cost estimates for the three alternatives are shown on **Tables 6-1, 6-2 and 6-3**. Due to the pre-conceptual nature of the estimate, a 25% contingency has been added to the total estimated cost for each alternative. The cost is based on prices in effect in the third quarter, 1999. The estimates assume that a private sector firm will design, construct and operate the facilities. Furthermore, it is assumed that all equipment will be pre-assembled, skid mounted and tested to the extent practical in manufacturer's facility before it is shipped to the site.

### **6.5.2 ROM Operating Estimate**

ROM operating costs for the three alternatives are on **Table 6-1, 6-2 and 6-3**. The O&M labor costs are based on an average labor salary of \$40,000 per year and a supervisory personnel salary of \$55,000 per year. The direct salary is multiplied by a factor of 1.3 to allow for employment tax, social security and fringe benefits.

Due to the conceptual level of the estimate, a 25% contingency has been included to the total estimated annual O&M costs. As mentioned above, it is assumed that the facility will be owned and operated by a private sector firm.

**Table 6-1. ROM Capital and O&M Cost Estimates for Plasma Generating Station**

<b>Line No.</b>	<b>Activity Description</b>	<b>Estimated Cost (\$ x 1000)</b>
<b>100</b>	<b>Engineering and Home Office</b>	
101	Home Office Engineering (3% of Equipment & Construction)	\$3,003
102	Architect Engineering (6% of Equipment & Construction)	\$6,006
103	Environmental/Permits (3% of Equipment & Construction)	\$3,136
<b>104</b>	<b>Subtotal</b>	<b>\$12,146</b>
<b>200</b>	<b>Process, Non-Process and Auxiliary Equipment</b>	
201	Incoming Truck Staging & Dumping	\$1,800
202	Sorting	\$2,000
203	Metal Recycle	\$1,400
204	Non-recyclable Refuse Loading	\$600
205	Feed	\$4,000
206	Plasma System	\$45,000
207	Turbine Generator	\$8,500
208	Natural Gas Tank Farm	\$1,200
209	Product Handling	\$800
210	Utilities	\$1,100
<b>211</b>	<b>Subtotal</b>	<b>\$66,400</b>
<b>300</b>	<b>Construction</b>	
301	Site Development (Grading, Roads & Paving, etc.)	\$2,250
302	Process and Auxiliary Buildings	\$2,750
303	Mechanical (10% of equipment)	\$6,640
304	Electrical/Instrumentation (15% of equipment)	\$9,960
305	Yard Utilities (1.2% of equipment)	\$797
306	Super-structures (1.5% of equipment)	\$996
307	Substructures (Equipment Pads, etc.)	\$1,400
308	Painting (1.5% of equipment)	\$996
309	Subtotal Direct Costs	\$25,789
310	Contractor Overhead and G&A (21% of Directs)	\$5,416
311	Contractor Fee (8% of Direct & Indirects)	\$2,496
<b>312</b>	<b>Subtotal</b>	<b>\$33,701</b>
<b>400</b>	<b>Misc.</b>	
401	Freight, Taxes and Insurance (12% of Equipment and Construction)	\$12,012
402	Subtotal Project	\$124,258
403	Contingency (25% of Project Subtotal)	\$31,065
<b>500</b>	<b>ROM Capital Cost Estimate</b>	<b>\$155,323</b>

Line No.	Activity Description	Estimated Cost (\$ x 1000)
600	<b>Annual Operating and Maintenance</b>	
601	Operating Labor (7 crews)	\$2,685
602	Maintenance Labor (2 crew)	\$767
603	Maintenance Parts & Equip Replacement Cost (10% of Equipment Capital)	\$6,640
604	Fuel/Electricity/Water, Etc.	\$749
605	Consumables	\$403
606	Tax Insurance & License Fees	\$600
607	<b>Subtotal</b>	<b>\$11,843</b>
608	Contingency (25% of O&M Subtotal)	\$2,961
700	<b>ROM Annual O&amp;M Cost Estimate</b>	<b>\$14,804</b>

**Table 6-2. ROM Capital and O&M Cost Estimates for Metal Recycling Plant**

Line No.	Activity Description	Estimated Cost (\$ x 1000)
<b>100</b>	<b>Engineering and Home Office</b>	
101	Home Office Engineering (3% of Equipment & Construction)	\$220
102	Architect Engineering (6% of Equipment & Construction)	\$440
103	Environmental/Permits (3% of Equipment & Construction)	\$181
<b>104</b>	<b>Subtotal</b>	<b>\$841</b>
<b>200</b>	<b>Process, Non-Process and Auxiliary Equipment</b>	
201	Incoming Truck Staging & Dumping	\$800
202	Sorting	\$850
203	Metal Recycle	\$1,200
204	Non-recyclable Refuse Loading	\$600
205	Utilities	\$200
<b>206</b>	<b>Subtotal</b>	<b>\$3,650</b>
<b>300</b>	<b>Construction</b>	
301	Site Development (Grading, Roads & Paving, etc.)	\$1,200
302	Process and Auxiliary Buildings	\$200
303	Mechanical (10% of equipment)	\$365
304	Electrical/Instrumentation (15% of equipment)	\$548
305	Yard Utilities (1.2% of equipment)	\$44
306	Super-structures (1.5% of equipment)	\$55
307	Substructures (Equipment Pads, etc.)	\$350
308	Painting (1.5% of equipment)	\$55
309	Subtotal Direct Costs	\$2,816
310	Contractor Overhead and G&A (21% of Directs)	\$591
311	Contractor Fee (8% of Directs and Indirects)	\$273
<b>312</b>	<b>Subtotal</b>	<b>\$3,680</b>
<b>400</b>	<b>Misc.</b>	
401	Freight, Taxes and Insurance (12% of Equipment & Construction)	\$880
402	Subtotal Project	\$9,050
403	Contingency (25% of Project Subtotal)	\$2,715
<b>500</b>	<b>ROM Capital Cost Estimate</b>	<b>\$11,765</b>
<b>600</b>	<b>Annual Operating and Maintenance</b>	
601	Operating Labor (2 crews)	\$767
602	Maintenance Labor (1 crew)	\$384
603	Maintenance Parts Material Replacement Cost (10% of Equipment Capital)	\$365
604	Fuel/Electricity/Water, Etc.	\$374
605	Consumables	\$115
606	Tax, Insurance & License Fees	\$250

<b>Line No.</b>	<b>Activity Description</b>	<b>Estimated Cost (\$ x 1000)</b>
607	Subtotal	\$2,255
608	Contingency (25% of O&M Subtotal)	\$564
700	ROM Annual O&M Estimate)	\$2,819



**Table 6-3. ROM Capital and O&M Cost Estimates for Gypsum Recycling Plant (\$ X 1,000).**

Line No.	Activity Description	Estimated Cost (\$ x 1000)
<b>100</b>	<b>Engineering and Home Office</b>	
101	Home Office Engineering (3% of Equipment & Construction)	\$147
102	Architect Engineering (6% of Equipment & Construction)	\$294
103	Environmental/Permits (3% of Equipment & Construction)	\$118
104	<b>Subtotal</b>	<b>\$558</b>
<b>200</b>	<b>Process, Non-Process and Auxiliary Equipment</b>	
201	Incoming Truck Staging & Dumping	\$450
202	Sorting	\$400
203	Gypsum Recycle	\$900
204	Bagging Station	\$210
205	Non-recyclable Refuse Loading	\$250
206	Utilities	\$150
207	<b>Subtotal</b>	<b>\$2,360</b>
<b>300</b>	<b>Construction</b>	
301	Site Development (Grading, Roads & Paving, etc.)	\$600
302	Process and Auxiliary Buildings	\$250
303	Mechanical (10% of equipment)	\$236
304	Electrical/Instrumentation (15% of equipment)	\$354
305	Yard Utilities (1.2% of equipment)	\$28
306	Super-structures (1.5% of equipment)	\$35
307	Substructures (Equipment Pads, etc.)	\$400
308	Painting (1.5% of equipment)	\$35
309	Subtotal Direct Costs	\$1,939
310	Contractor Overhead and G&A (21% of Directs)	\$407
311	Contractor Fee (8% of Directs & Indirects)	\$188
312	<b>Subtotal</b>	<b>\$2,534</b>
<b>400</b>	<b>Misc.</b>	
401	Freight, Taxes and Insurance (12% of Equipment & Construction)	\$587
402	Subtotal Project	\$6,040
403	Contingency (25% of Project Subtotal)	\$1,509.92
<b>501</b>	<b>ROM Capital Cost Estimate</b>	<b>\$7,550</b>
<b>600</b>	<b>Annual Operating and Maintenance</b>	
601	Operating Labor (1 crews)	\$384
602	Maintenance Labor (0.5 crew)	\$192
603	Maintenance Parts Material Replacement Cost (10% of Equipment Capital)	\$236
604	Fuel/Electricity/Water, Etc.	\$262
605	Consumables	\$58
606	Tax, Insurance & License Fees	\$200
607	<b>Subtotal</b>	<b>\$1,331</b>

<b>Line No.</b>	<b>Activity Description</b>	<b>Estimated Cost (\$ x 1000)</b>
608	Contingency (25% of O&M Subtotal)	\$333
700	<b>Total Project O&amp;M Estimate)</b>	<b>\$1,664</b>